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of

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for

ULTRAVIOLET INDICATING CLOSURE FOR CONTAINERS

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BACKGROUND

1. Field of the Invention

The present invention relates to ultra-violet level indicators, and more particularly to photo-chromatic ultraviolet indicating closures, such as lids or caps, fitable on containers comprising an ultraviolet radiation protection product, wherein the color of the indicating closure transforms to correspond to the level of exposed ultraviolet radiation.

3. Background of the Invention and Related Art

Several devices exist in the art that are capable of measuring and/or indicating the amount or intensity of ultraviolet radiation present in the atmosphere at a given time. Many of these devices have been reduced to adhesives that can be attached to various devices, containers, or other items. For example, United States Patent No. 6,405,867 B1 to Moore discloses a bottle that includes a base and a continuous sidewall extending upwardly from the periphery of the base to a neck. The base and sidewall define a cavity for containing a suncream or the. The package also contains display means for providing a person with the indication of the intensity of UV radiation, or another ambient condition, incident upon the package. However, the device in Moore is merely an adhesive that may wear-out, thus losing its accuracy, or even peel off over time. Moreover, the device in Moore comprises a scaled meter or label that goes through a series of color changes depending upon the intensity of ultraviolet radiation. The problem with this system is that it is difficult to read at times because colors corresponding to various intensities of ultraviolet radiation will be similar, perhaps only differing in shade, due to the limitations of the ultraviolet absorbing material contained within the device that induces a color change based on ultraviolet intensity.

Other devices are also available, such as those found in United States Patent Nos. 3,787,687 to Trumble, 3,903,423 to Zweig, and 6,060,321 to Hovorka. Each of the devices disclosed in these prior patents comprises a dosimeter that is also based upon a metered scale. Although these devices may be implemented in a number of different technologies, the problem of scaled metering still remains.

SUMMARY AND OBJECTS OF THE INVENTION

In response to the deficiencies in the prior art as discussed above, and in accordance with the invention as embodied and broadly described herein, the present invention features an ultraviolet indicating closure comprising (a) a primary support body; (b) means for fitting the primary support body and the closure onto a container, wherein the container comprises a specific, pre-identified ultraviolet radiation protecting product; (c) at least one ambient surface located on the primary support body, wherein the ambient surface is exposed, at least in part, to ambient conditions and ultraviolet radiation; and (d) an ultraviolet radiation indicator integrally formed within at least a portion of the ambient surface and comprising a first, base color, the ultraviolet radiation indicator comprising a photo-chromic makeup that induces a single color change within the ultraviolet radiation indicator to a second, indicating color based upon breach of a pre-determined, incorporated ultraviolet radiation intensity threshold by the ultraviolet radiation incident upon the ambient surface, the single color change and the second, indicating color corresponding to and signaling the appropriateness for use of the specific, pre-identified ultraviolet radiation protecting product formulated within the container.

The second, indicating color is induced or activated upon breach of the pre-determined, incorporated ultraviolet radiation intensity threshold. This threshold may be established to fall within any desired range of ultraviolet wavelength. For instance, the threshold may be established between the 280 – 300 nm wavelength range, wherein the single color change takes place if the ultraviolet radiation incident upon the ambient surface is within this range. Or, the threshold may be established between the 300 – 320 nm wavelength range, wherein the second, indicating color is different than the one for the 280 – 300 nm wavelength range. Essentially, any range of ultraviolet wavelengths may be designated to produce an identified second, indicating color, depending upon and corresponding to the intensity of that particular ultraviolet radiation. To do this, the photo-chromatic makeup within the ambient surface and/or ultraviolet indicator is altered accordingly.

In one preferred, exemplary embodiment, the present invention photo-chromatic ultraviolet indicating closure comprises a plastic cap or lid fitable on the end of a container comprising an ultraviolet radiation protection product, such as lip balm or sunscreen lotion. The plastic indicating closure comprises a photo-chromatic material composition designed to change color when exposed to ultraviolet radiation, such as sunlight. Specifically, the plastic indicating closure comprises materials designed to change color according to the amount and intensity or level of ultraviolet radiation to which the indicating closures are exposed. For example, if the cap or lid changes to purple, then there is sufficient ultraviolet radiation to warrant using a designated corresponding amount of ultraviolet radiation protection product, such as a sun protection factor (SPF) 30 sunscreen. The ultraviolet radiation protection products contained within

the containers preferably comprise different SPF ratings and individuals wishing to purchase one of these products that day will purchase the product capable of providing the most accurate protection for that day based on the level of ultraviolet radiation as indicated by the color of the ultraviolet indicating closure.

The ultraviolet radiation indicator comprises a photo-chromatic makeup or composition, such as a photo-chromatic dye, that is integrally formed within a portion of the closure or the entire closure during manufacture. Other similar ultraviolet radiation detecting substances are contemplated herein, that are capable of indicating ultraviolet intensity.

In an alternative embodiment, the ultraviolet index is used to identify the ultraviolet protection product within the container. This can complement or be used in addition to the SPF.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the manner in which the above-recited and other advantages and features of the invention are obtained, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 illustrates a perspective view of a lip balm sun protection product comprising a lid or cap fittable onto a container, wherein the lid or cap comprises an

ultraviolet radiation indicator along its top according to an exemplary embodiment of the present invention;

Figure 2 illustrates several ultraviolet indicators and an array of colors that may be assigned to different closures; and

Figure 3 illustrates a front view of an exemplary alternative sun protection product comprising a flip-top lid fittable onto a lotion container, wherein the lid comprises an ultraviolet indicator along its sidewall.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It will be readily understood that the components of the present invention, as generally described and illustrated in the figures herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the system and method of the present invention, and represented in Figures 1 through 3, is not intended to limit the scope of the invention, as claimed, but is merely representative of the presently preferred embodiments of the invention.

The presently preferred embodiments of the invention will be best understood by reference to the drawings wherein like parts are designated by like numerals throughout.

The present invention describes a method and apparatus for indicating an appropriate ultraviolet radiation protection product to be used depending upon existing or present conditions.

The following more detailed description is separated into sections for readability. The first section pertains to a general discussion on ultraviolet light and/or radiation, and the second section deals with the specifics regarding the present invention ultraviolet

indicating closure. These sections are not meant to limit or narrow the scope of the present invention, but are merely provided to assist the reader in understanding the disclosure.

GENERAL STATEMENTS ABOUT ULTRAVIOLET LIGHT OR RADIATION

Ultraviolet (UV) light or radiation is a form of radiation which is not visible to the human eye and that is an invisible part of the electromagnetic spectrum. Depending upon its intensity, UV light is capable of injuring or damaging cells in the epidermis by diffusing into the inner layer and causing an enlargement of vessels. If over exposed to UV light, many possible side effects are possible, such as blisters, sun spots, pre-mature aging, and even more serious, skin cancer.

UV light exists along the electromagnetic spectrum between about one (1) to four hundred (400) nanometers. UV rays are classified into three regions according to the frequency of their wavelengths - UVA, UVB, and UVC. The wavelengths are so small they are measured in nanometers (one nanometer equals one billionth of a meter). UVA comprises a wavelength between about 320 - 400 nm, UVB comprises a wavelength between about 280 and 320 nm, and UVC light comprises a wavelength between about 1 and 280 nm. Ozone absorption is so strong in the UVC range ($\lambda < 280$nm) that solar radiation in these wavelengths does not reach the earth's surface. However, as the wavelength is increased through the UVB range (280nm $< \lambda <$ 320nm) and into the UVA range (320nm $< \lambda <$ 400nm) ozone absorption becomes weaker, until it is undetectable at about 340nm. As such, it is the higher wavelength UV radiation (UVA and UVB) that penetrates the atmosphere making all potentially at risk to exposure, or rather over exposure, and is particularly of note.

UVA penetrates deepest into the dermis. UVA is the primary source for causing long-term effects from the sun, such as such as wrinkles, blotches, and age spots. In addition, UVA stimulates melanin to tan, and is primarily responsible for tanning. UVA contributes only some to sunburn.

UVB is primarily responsible for sunburning and contributes little to tanning. UVB presents a greater concern because of its ability to cause skin cancer, including squamous cell carcinoma, and keratinosis.

Currently, there are many current UV radiation protection products or compositions currently available to protect one from over exposure to UV radiation. These are most commonly found in the form of lip balms or ointments, cosmetic makeup, sunscreens, suntan lotions or oils, and other topical dermal products. Each of these is specifically formulated to contain ingredients which either absorb or block and scatter UV rays. Moreover, these products are formulated to provide various levels of protection from UV radiation. The most common indicator of the level of protection provided by a UV radiation protection product is known as the Sun Protection Factor (SPF) rating system, which has been established by the Food and Drug Administration to measure primarily the amount of UV, and particularly UVB, sunburn protection the product will provide. Essentially, the SPF indicates how much longer an individual may be exposed to UV radiation before becoming burned when using the UV protection product as opposed to not using such a product. Other factors are involved, such as the skin type of the individual using the product. For example, a fair skinned person who would normally start to burn after 10 minutes in the sun would receive 15 times that with an SPF 15 (150 minutes or 2 1/2 hours). Comparatively speaking, if a person with darker skin takes

longer to burn without protection, say 20 minutes, an SPF 15 would give him 300 minutes (5 hours) of additional exposure time before burning.

To increase awareness and educate people on the dangers of over exposure to UV light or radiation, a system has been developed to categorize the intensity of UV radiation at a present moment. This system, known as the UV Index is a forecast, of the amount of UV expected to reach the Earth's surface on a particular day when the sun is highest in the sky. The higher the index, the faster UV radiation causes damage to the skin and eyes. Many factors affect the index, such as elevation, cloud cover, the amount of ozone, and position of the sun in the sky. As such, the UV index is highly dynamic. However, the system is an accurate indicator of UV radiation, or rather the intensity of UV radiation, and should be closely monitored in any effort to avoid overexposure to sunlight. Moreover, the UV index is capable of providing insight on the particular type of UV radiation protection product that should be used to optimize protection from harmful UVA and UVB radiation.

The UV index comprises a scale of numerical indicators that represent the intensity of UV radiation. This scale ranges from 1 to 10+, with 1 being the lowest amount of UV radiation and 10 or above representing the most intense UV radiation. Specifically, UV exposure levels are represented by the UV index as follows:

Index Value	Exposure Level
0-2	Minimal
3-4	Low
5-6	Moderate
7-9	High
10+	Very High

Based on these values, the intensity of UV radiation can be communicated and used to identify the type of protection needed.

Figure 1 illustrates a perspective view of one exemplary embodiment of the present invention UV indicating closure 10 (hereinafter referred to as "closure 10") having a primary support body 14 and means for fitting the primary support body on a container 6, shown as a lip balm dispenser containing a UV radiation protection product in the form of a lip balm.

Means for fitting primary support body 14 on container 6 may comprise any type of assembly, device, or system known in the art, and preferably comprises an attachment means 18 in the form of an interference fit assembly, a screw-on assembly, a snap-on assembly, and others. Figure 1 illustrates attachment means 18 as a snap-on assembly comprising a cap or lid 50 that fits over or snaps on to base 54 as commonly known in the art.

Closure 10 further comprises at least one ambient surface 22 located on primary support body 14 that is exposed, at least in part, to ambient conditions and UV radiation, or in other words, that is capable of being exposed to UV radiation. In Figure 1, lid 50 comprises several ambient surfaces, illustrated as ambient surfaces 22 and 24.

As shown, ambient surface 22 comprises a UV radiation indicator 26 integrally formed within at least a portion of ambient surface 22, which is the top or uppermost portion of lid 50. Lid 50 fits onto container 6 in order to store the UV radiation protection product 30 (shown as lip balm) within container 6. Placement of UV radiation indicator 26 may also be on ambient surface 24, or both ambient surfaces 22 and 24. UV indicator 26 functions to absorb UV light or radiation. UV indicator 26 may comprise any type of UV absorber, but preferably comprises a photo-chromatic makeup.

UV indicator 26 is integrally formed with ambient surface 22 during manufacture so as to be a part of the material composition of ambient surface 22. Integrating UV indicator 26 into the material makeup of ambient surface eliminates many of the problems associated with similar functioning prior art stick on or adhesive indicators.

Some embodiments of closure 10 comprise UV radiation indicator 26 integrally formed within only an identified portion of ambient surface 22. Other embodiments of closure 10 comprise UV radiation indicator 26 integrally formed in the entire area of ambient surface 22. As such, any shape, size, or location of UV indicator 26 within either all or part of ambient surface 22 is contemplated herein.

UV radiation indicator 26 also comprises a first, base color 60. This color is the normal or initial or base color if there is no UV radiation incident upon the ambient surface containing UV radiation indicator 26, or if the UV radiation incident upon the ambient surface is less than the built-in threshold for activating the single color change within the ambient surface as described below. In an exemplary embodiment, UV radiation indicator 26 comprises a photo-chromatic makeup or composition, such as a photo-chromatic dye or any other similar type of composition, that functions to induce or generate a single color change within UV radiation indicator 26 and ambient surface 22 if exposed to a certain amount of UV radiation. The level of radiation required to initiate or trigger this single color change is dependent upon the particular composition and/or formulation of photo-chromatic material. As will be explained below, this concept refers to the radiation indicating threshold that is designed into UV radiation indicator 26. Once the UV radiation incident upon ambient surface 22 is sufficient to breach this threshold, the photo-chromatic composition is activated, thus causing UV radiation indicator 26 to

change colors to a second, indicating color 64 (first and second colors are represented in Figure 1 as shown. Although shown together, on an actual closure, first and second colors will be separate and independent of one another and will not show up concurrently). This second, indicating color, if triggered, corresponds to the level of UV radiation currently present in the atmosphere, and signals the appropriateness for use of the specific or particular UV radiation protection product formulated and existing within container 6 that was previously identified and formulated as the proper protection for such conditions.

Figure 2 illustrates several ambient surfaces comprising a UV indicator 26. Figure 2 serves to illustrate the many possible color combinations that can be created and built-into UV indicator 26 via the particular type, quantity, and configuration of photo-chromatic material used therein. For example, depending upon the intensity of the UV radiation, UV indicator 26 may be designed to undergo a color change from first, base color 60 to any one of different colors 64, 66, 68, 70, 72, 74, 76, 78, 80, and 82. Moreover, each color may succeed the other in vibrancy based upon the intensity of the UV radiation incident on the ambient surface and absorbed by UV indicator 26. Essentially, any color combination and/or assignment is contemplated herein.

Referring back to Figure 1, closure 10 may be comprised of any material capable of integrating at least one photo-chromatic material (e.g., photo-chromatic substances or compositions, such as photo-chromatic dyes) within its material makeup. In this sense, closure 10 functions as the matrix or medium for the photo-chromatic material(s). Moreover, integration of such photo-chromatic material(s) means that such material(s)

is/are dissolved, suspended, dispersed, embedded, fixed, or otherwise formed with the material of the closure.

Preferred closure materials comprise any suitable polymer, such as polycarbonates, polystyrenes, polyolefins, polyacrylates, polyvinyl derivatives, polyester derivatives, polyvinyl chloride, cellulose derivatives, polyurethane, polyethylene terephthalate, silicone resins, triethylene glycol dimethacrylate, polymethylmethacrylate, epoxy resins, high and low density polyethylene, and high and low density polypropylene. Specific manufacturing processes include mixing the photo-chromatic material with the polymer prior to molding, to properly disperse or distribute the photo-chromatic material as desired.

The photo-chromatic material mixed with the polymer is pre-identified and formulated or designed to be able to accept a given or calculated amount and intensity level of UV radiation before it undergoes a change in color. If the threshold radiation level is reached, the photo-chromatic material is activated, thus inducing the single color change within UV radiation indicator 26 and signifying the appropriateness for use of the contained UV radiation protection product corresponding to the level and intensity of the UV radiation currently existing or present within the atmosphere. As such, the photo-chromatic material is pre-programmed to go active only after it is exposed to a certain amount and intensity of UV radiation and is built-into the material makeup of closure 10.

The specific photo-chromatic compositions, substances, and materials used, as well as the processes used to manufacture these is/are not specifically recited herein as they are commonly known in the art. Although significant and patentably distinct differences exist, the present invention utilizes similar ultraviolet absorbing technology as

described in United States Patent Nos. 3,787,687 to Trumble, 3,903,423 to Zweig, and 6,060,321 to Hovorka, along with their associated references, as well as United States Patent Publication Nos. US 2002/0117633 to Questal et al. and US 2003/0008409 to Spearman et al., each of which are incorporated by reference only in part herein. It should be noted that it is only intended to utilize that type of technology that can incorporate the ultraviolet absorbing material (e.g. photo-chromatic material) into UV indicator 26 to produce a single color change, and that can be varied to produce different colors depending upon the type, amount, or processes used to correspond directly to the intensity of ultraviolet radiation to which the UV absorption material is exposed. Thus, the portions of these references that teach a device that utilizes metered or scaled color changes is not incorporated herein as this is in contrast to that taught herein. In other words, only the ultraviolet absorbing technology taught in these references is to be incorporated herein.

The present invention further comprises a pre-determined UV radiation intensity threshold that is incorporated or built-into the photo-chromatic material to allow only a single color change. The technology behind this is not specifically described herein, but is well known in the art. It should be noted however, that the present invention UV indicator comprising the photo-chromatic material is designed to comprise only a first, base color and a second, indicating color. Photo-chromatic materials allowing multiple color changes, or a range of colors depending upon intensity are not intended for use with the present invention. Such concepts and technological uses are described in prior art applications and function differently than the technology presented herein. Of course, it is recognized that the present invention UV indicator may go through various color

changes or shades of a color to arrive at the second, indicating color, but such transformation is intended to be as quick as possible.

The UV intensity threshold functions to govern when UV radiation indicator 26 changes from its first, base color to its second, indicating color. Each range of UV intensity factors corresponds to or comprises a different UV radiation intensity threshold so that only that particular closure and associated container, and particularly the UV indicator thereon, comprising the photo-chromatic material designed to change colors at the present UV intensity will actually display or go through the color change.

The advantages of providing a single color change and an integrated UV indicator within a closure are several. First, since there is only a single color change, selective SPF grades can be assigned a specific color for the specific UV radiation protection product contained within the associated container. Second, there is less confusion as to which color is actually represented or showing. Third, no measuring of UV radiation is done. Rather, the closure will change color in accordance to the specific pre-determined UV radiation intensity threshold built-into the UV indicator and closure, as dictated by the engineered or designed type and quantity of photo-chromatic material used therein. Fourth, such a design eliminates the need for scaled meters or labels that can wear-out and become less accurate, or wear off entirely over time.

The present invention closure utilized a pre-identified UV intensity factor and at least one corresponding assignment criteria. In one exemplary embodiment, the UV intensity factor comprises the wavelength of the present UV radiation, measured in nanometers, incident upon ambient surface 22 of closure 10. Corresponding assignment criteria comprise the SPF factor of the UV radiation protection product present in the

container, the UV index, and the assigned color of the second, indicating color. Thus, if the intensity level of the UV radiation breaches the threshold defined by and that falls within a certain range, then the photo-chromatic materials designed to react at such level will activate and change to the color previously determined and assigned to that particular wavelength. Likewise, that particular second, indicating color will correspond to the previously determined UV radiation protection product contained within container 6. As such, if the UV radiation is intense enough to breach the built-in threshold for that particular range of UV intensity factors, photo-chromatic material is activated and the UV indicator changes its color, then this will signal the appropriateness for use of the UV radiation protection product contained within the container associated with closure 10.

To illustrate this concept further, the following tables represent exemplary quantitative figures that may be assigned to the UV Index, the SPF of the UV radiation protection product, and the second, indicating color, each as they correspond to the particular intensity level of UV radiation, as pre-identified by its wavelength in nanometers. The greater the wavelength, the more intense the UV radiation. Table One represents a more specific breakdown of the UV intensity identification factor and corresponding assignment criteria, while Table Two represents a more general illustration of the same.

Table One

UV Wavelength (nm)	UV Index	SPF	Color
280 – 290	1 – 2	<1	1
290 – 300	2 – 3	<5	2
300 – 310	3 – 4	<10	3
310 – 320	4 – 5	<15	4
320 – 330	5 – 6	<30	5
330 – 340	6 – 7	<30	6
340 – 350	7 – 8	<45	7

350 – 360	8 – 9	<45	8
360 – 370	9 – 10	<50	9
370 – 400	10+	<50	10

Table Two

UV Wavelength (nm)	UV Index	SPF	Color
280 – 300	0 – 2	<1	1
300 – 320	3 – 4	<15	2
320 – 340	5 – 6	<30	3
340 – 350	7 – 9	<45	4
350+	10+	<50	5

As can be seen from the above two tables, any combination of UV intensity identification factors and corresponding assignments can be made and is contemplated by the present invention. As such, the foregoing tables are to be taken as illustrative only, and are not meant to be limiting in any way. Indeed, one ordinarily skilled in the art will recognize other types of UV intensity identification factors and corresponding assignments that can be made, including use of other identifiers and assignment criteria.

As mentioned, the present invention closure may be embodied in several forms. Figure 3 illustrates an alternative embodiment, wherein closure 10 comprises a flip-top lid 90 fittable onto container 6 comprising a pre-determined UV radiation protection product therein. Closure 10 functions similar to that described above, but UV indicator 26 is shown positioned along ambient surface 24 located along the sidewall of lid 90, rather than on the top. One ordinarily skilled in the art will recognize the several different designs closure 10 may consist of, as well as the relative positioning of UV indicator 26 on closure 10.

The present invention further comprises a method for indicating an appropriate ultraviolet radiation protection composition for use based on a present ambient condition.

The method comprises the steps of: filling a container with a specific, pre-determined ultraviolet radiation protection product; fitting a closure device onto the container to manage storing and dispensing of the ultraviolet radiation protection product, wherein the closure comprises at least one ambient surface and a photo-chromatic makeup integrally formed within the ambient surface; inducing a single color change within the ambient surface from a first, base color to a second, radiation indicating color, wherein the second, indicating color corresponds to a specific amount and intensity of ultraviolet radiation; and correlating the specific, pre-determined ultraviolet radiation protection product with the second, indicating color to ensure appropriateness of use.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. In addition, the described embodiments are to be considered in all respects only as illustrative and not restrictive. As such, the scope of the invention is indicated by the appended claims, rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed and desired to be secured by Letters Patent is: